

Matthew Johnson
NASA Ames Research Center
matthew.s.johnson@nasa.gov

Evaluating summer-time ozone enhancement events in the southeast United States

This study evaluates source attribution of ozone (O_3) in the southeast US within O_3 lamina observed by the University of Alabama in Huntsville (UAH) Tropospheric Ozone Lidar Network (TOLNet) system during June 2013. This research applies surface-level and airborne in situ data and chemical transport model, GEOS-Chem, simulations in order to quantify the impact of North American anthropogenic emissions, wildfires, lightning NO_x , and background/stratospheric transport on the observed O_3 lamina. During the summer of 2013, two anomalous O_3 layers were observed and evaluated: 1) a nocturnal near-surface enhancement and 2) a late evening elevated (3-6 km above ground level) O_3 plume. A “brute force” zeroing method was applied in GEOS-Chem to quantify the impact of individual emission sources and transport pathways on the vertical distribution of O_3 during the two observed lamina. These model simulations suggest that the nocturnal O_3 enhancement on June 12, 2013 below 3 km was primarily due to wildfire emissions and the fact that daily maximum anthropogenic emission contributions occurred during these night-time hours. During the second case study it was predicted that above average contributions from background/stratospheric transport was largely contributing to the O_3 lamina observed on June 29, 2013 between 3-6 km. Further evaluation suggested that a stratospheric intrusion was likely the main source contributing to this O_3 enhancement between 3-6 km. Supporting information from other models, remote-sensing observations, and ground-based/airborne in situ data agree with the source attribution predicted by GEOS-Chem simulations for both case studies. Overall, this study demonstrates the dynamic atmospheric chemistry occurring in the southeast US and displays the various emission sources and transport processes impacting O_3 enhancements at different vertical levels of the troposphere.

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